Tektronix

Time Alignment of Multiple Real-Time High Bandwidth Scope Channels

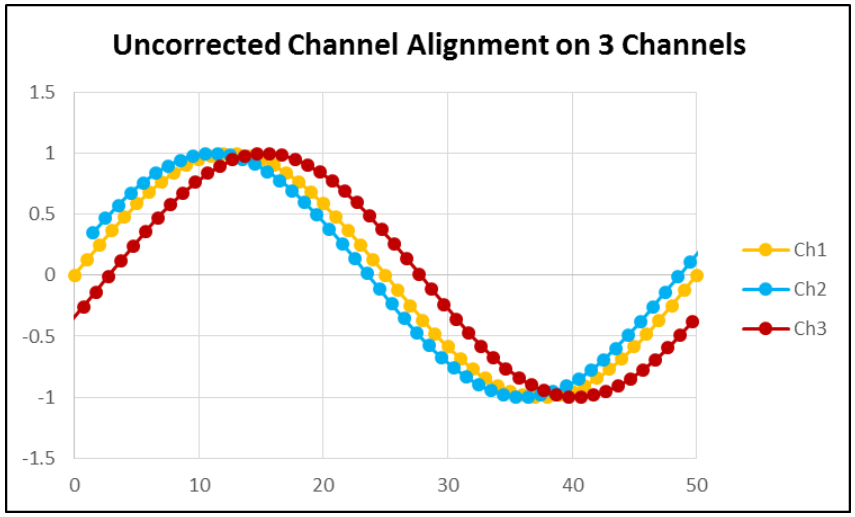
Time Synchronization Between Scope Channels for Data Acquisition

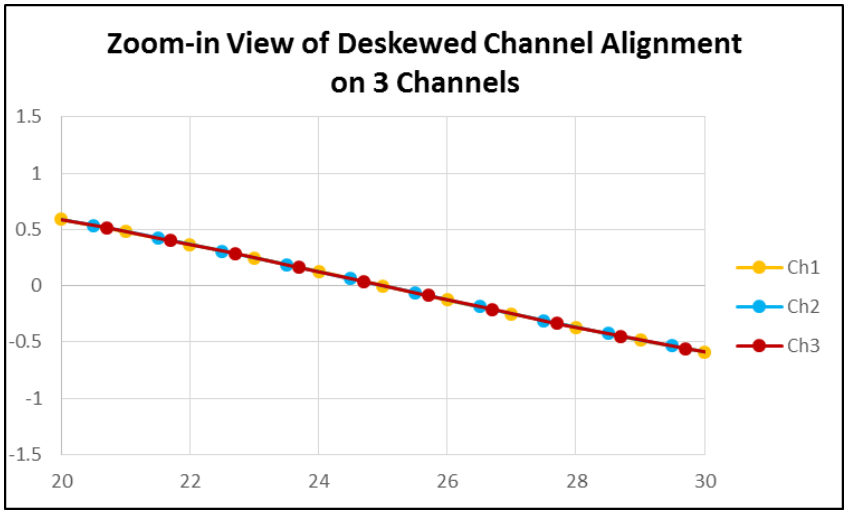
- Large Acquisition Systems Often Require Synchronization of Multiple Instruments to Provide Needed Channel Count
- Accurate Alignment of Channels Across Multiple Chassis can be Challenging
- Single Shot Acquisitions
  - Pk-Pk Alignment Specs Set Best (Worst Case) Performance Expectations for PDV
  - RMS Alignment Specs Not Useful for This Application

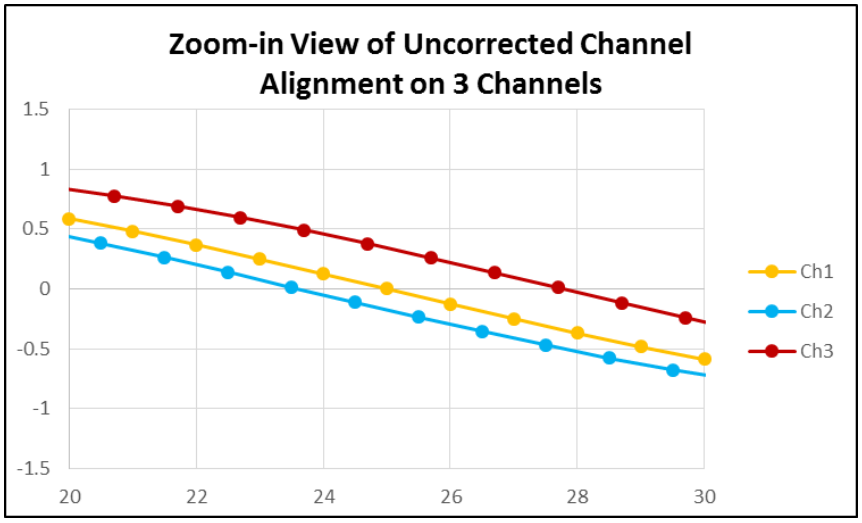
Sources of Channel Alignment Error

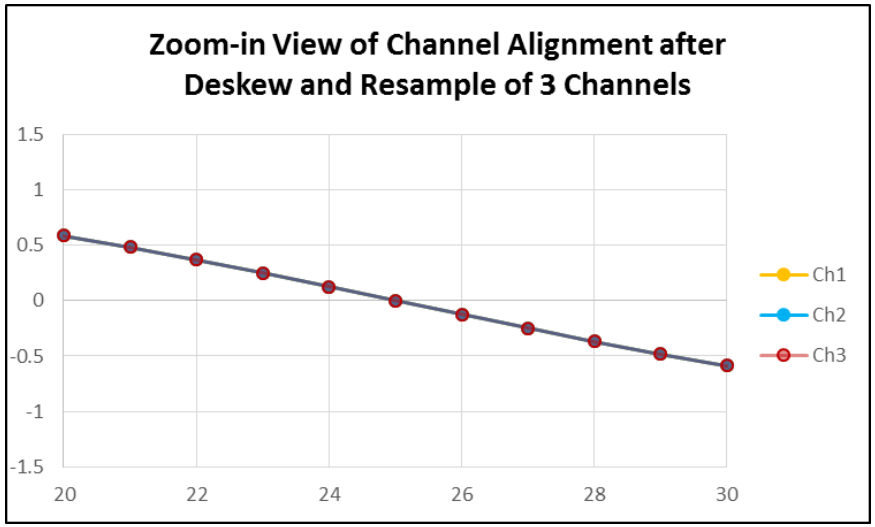
- Sample Alignment
- Trigger Jitter
- Skew as a Function of Frequency
- Skew as a Function of Temperature

Sample Alignment





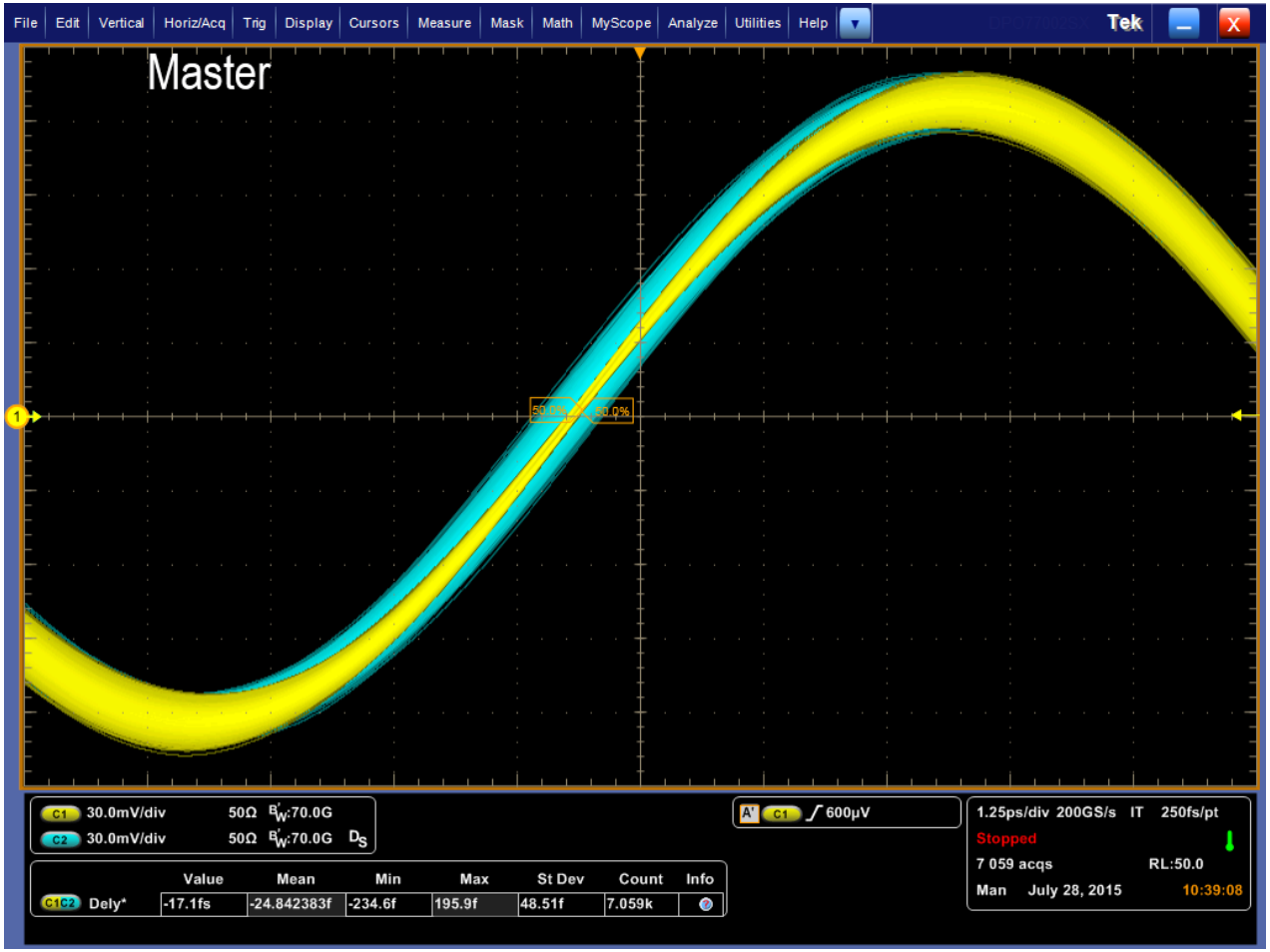




Trigger Jitter

- Trigger Jitter Can Dramatically Impact Channel Alignment When Synchronizing Multiple Chassis
  - Each Chassis can Receive Trigger Signal at Slightly Different Times
- Use Analog Channel When Available as Trigger Input, as This Provides Highest Signal Fidelity for Trigger Signal, and Lowest Trigger Jitter
  - Non-active (“Off”) channels can be used as trigger source
- Use System Level Trigger Synchronization Features (e.g. Tek’s UltraSync) to Optimize Trigger Alignment Across Multiple Chassis

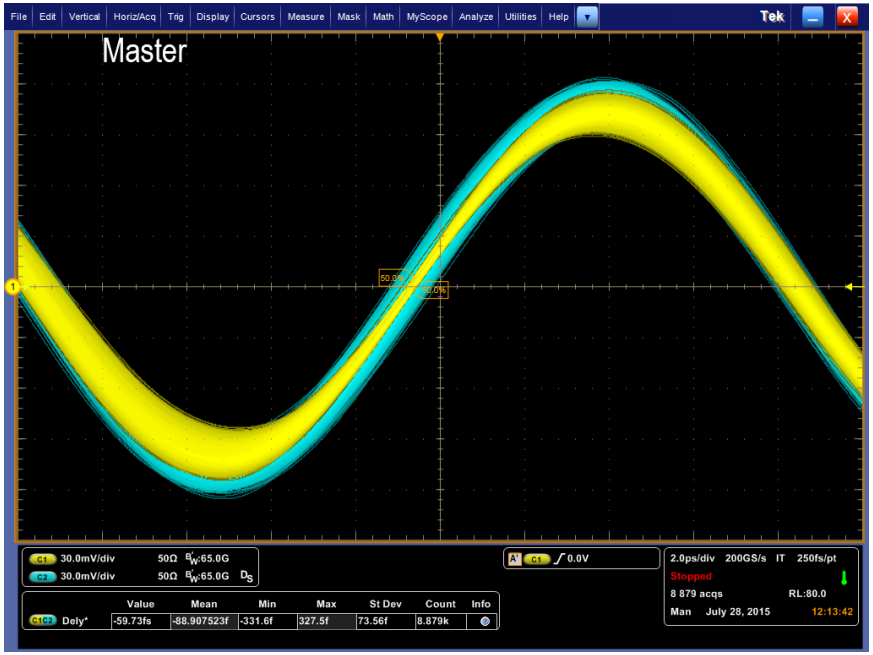
Channel-to-Channel Skew Stability: DPS77004SX Two-Unit System



430fs pk-pk, 48.5fs$_{RMS}$, 65GHz sinewave

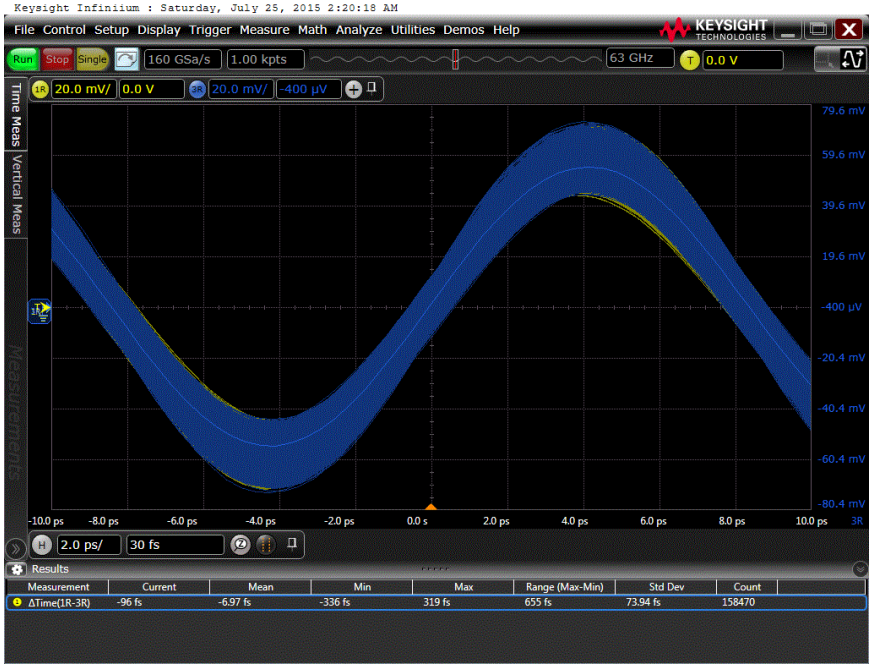
Channel-to-Channel Skew: 2-Chassis vs 1-Chassis

- 55GHz sinewave applied to both instruments
- Both Systems Manually deskewed to initially align channels
- Measurement shows alignment over thousands of acquisitions



Tektronix 77002SX Multi-Chassis

659.1fs pk-pk, 73.56fs$_{RMS}$

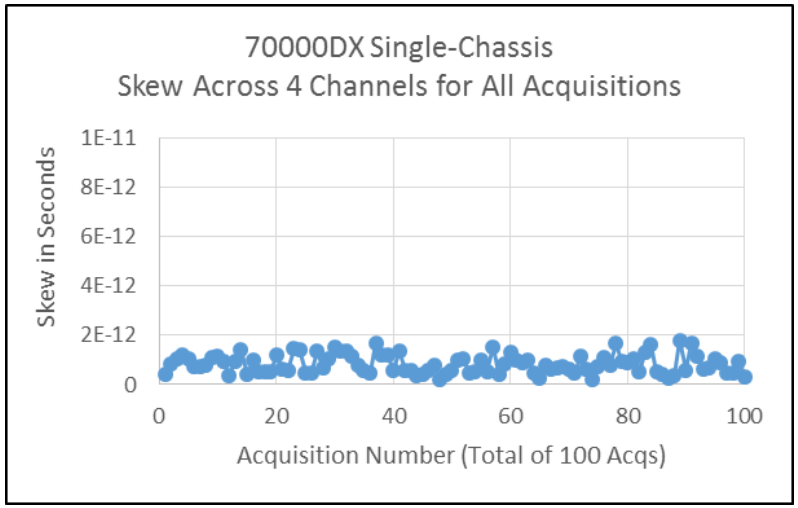


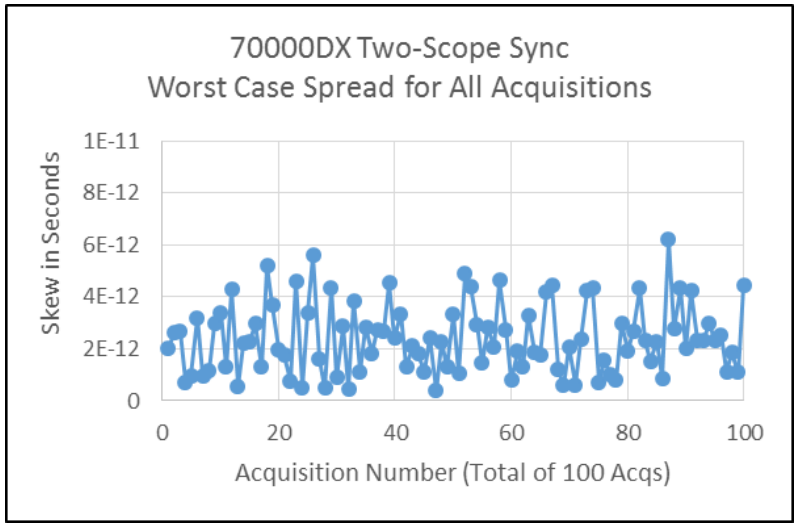
Other Vendor Single-Chassis

655fs pk-pk, 73.94fs$_{RMS}$

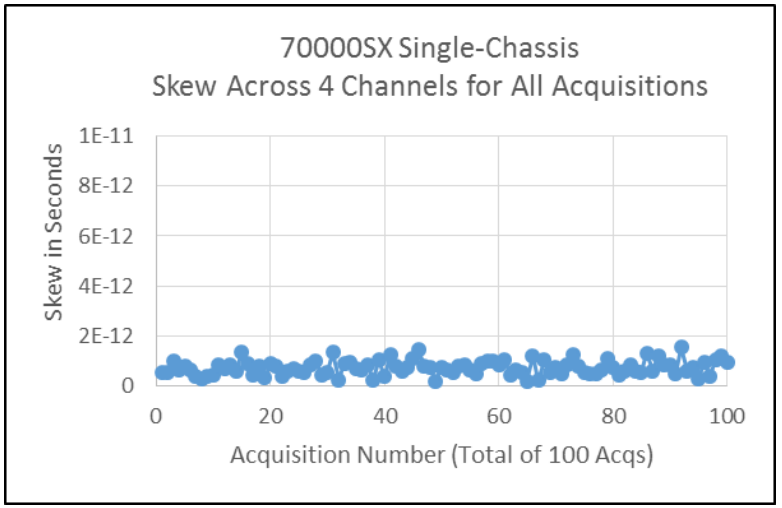
Comparison of Tek Solutions

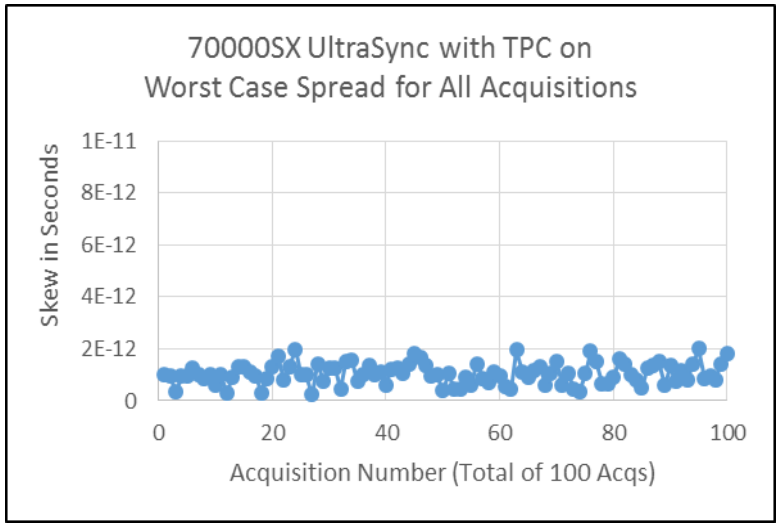
Previous Generation: 70kDX



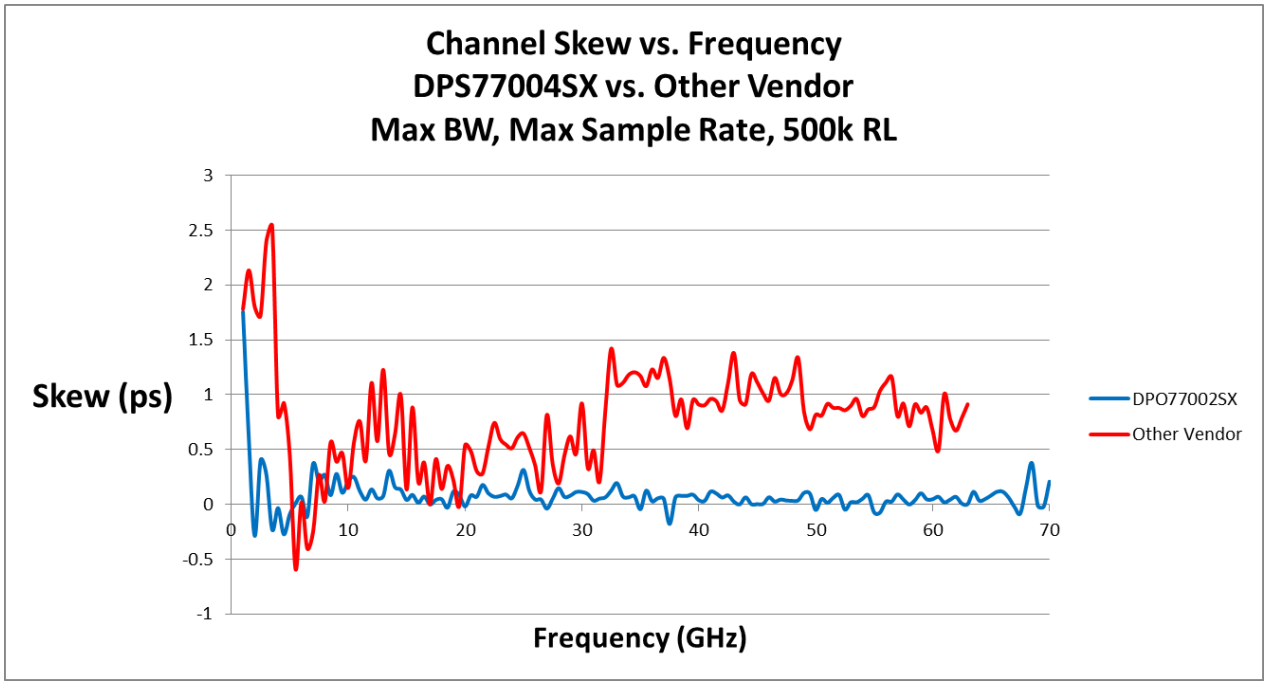


Latest Generation: 70kSX





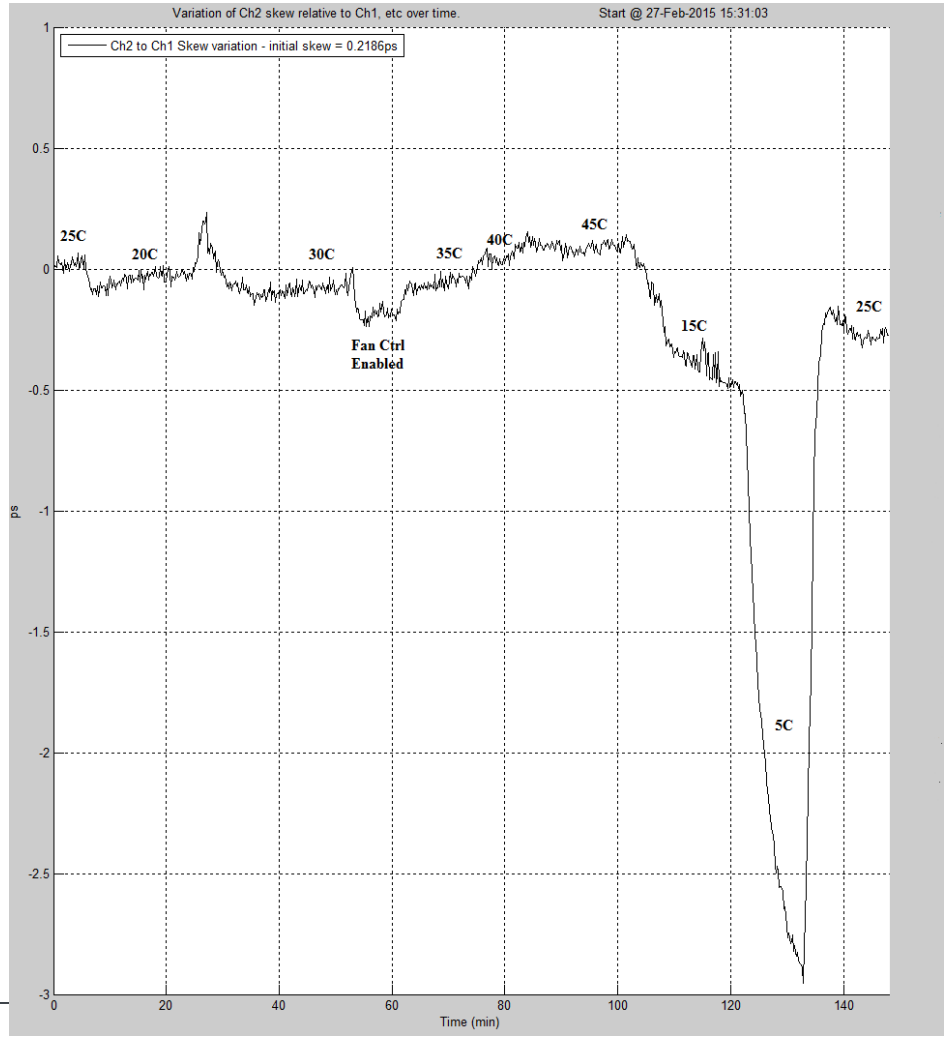
Channel Skew vs. Frequency Comparison



- Essentially Group Delay Function Between Channels
- Comparison Between Two Different Manufacturer's Scopes
- Skew Measured Between Two Channels as Frequency is Varied

Ch-Ch Skew vs Temperature with UltraSync – Temp Chamber Test

- Ambient temp range from +45C to +5C
- Known changes in coax occur below +15C, affecting dielectric. This is cause of dip seen in plot.



Scalable Performance

- Compact instrument for increased configuration flexibility
- UltraSync high performance synchronization for multi-unit configurations
- Multi-unit systems operate like single instrument
- **Each unit is 4U High in Rackmount**

Compact 5 ¼" package with optional Auxiliary Front Panel and external display for user interface

Additional performance using multiple units

Configuration flexibility with precisely-synchronized timing

UltraSync High Performance Synchronization & Control bus

- 12.5 GHz Sample Clock Reference
- Coordinated Trigger
- High speed data path

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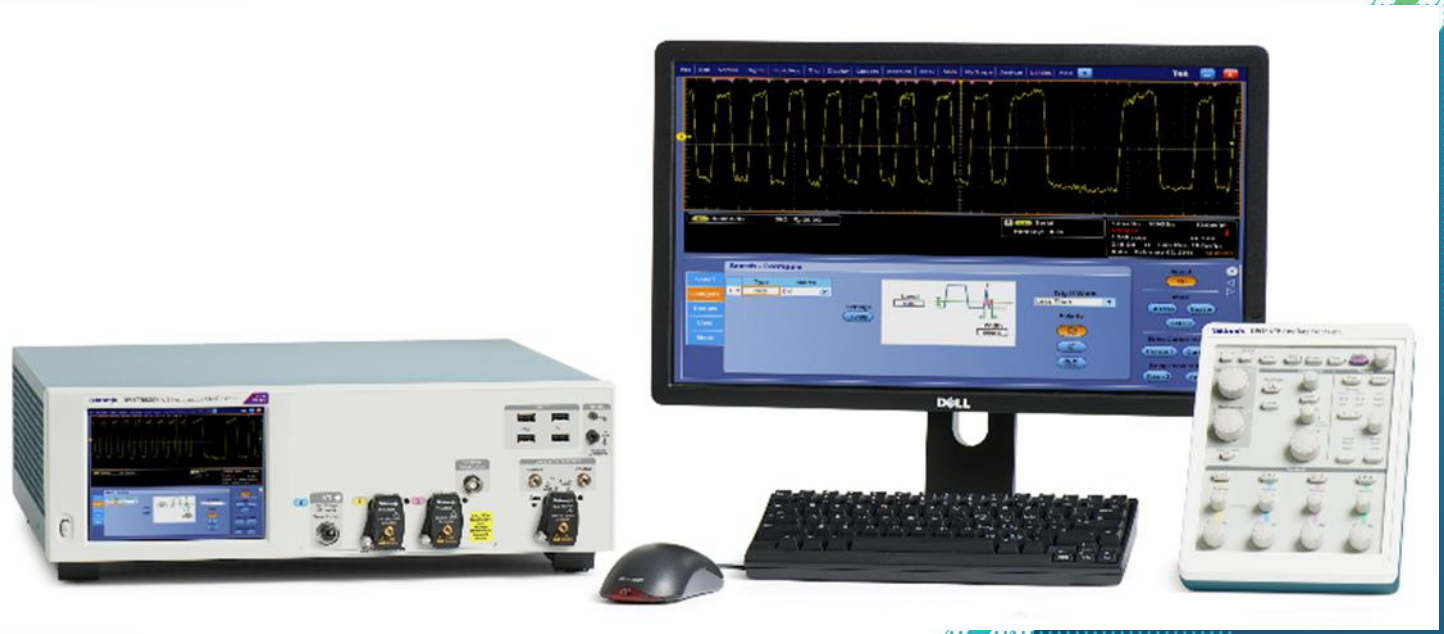

ATI Performance Oscilloscope

- 70GHz Analog Bandwidth, 4.3ps rise time (20%-80%)
- 200GS/s Sample Rate
- <125fs jitter noise floor
- ≥25GHz Edge trigger bandwidth
- Compact 5 ¼” Oscilloscope package

- ✓ Low-noise ATI architecture
- ✓ Best-in-class signal capture
- ✓ Compact package with precise multi-unit sync

- 1 channel x 70GHz bandwidth
- Single-ended, 100mV$_{fsr}$ to 300mV$_{fsr}$
- 200GS/s sample rate
- Up to 1 Gsamples record length

[OR]

- 2 channels x 33GHz bandwidth
- Single-ended, 62.5mV$_{fsr}$ to 6V$_{fsr}$
- 100GS/s sample rate per channel
- Up to 1 Gsamples record per channel

UltraSync Multi-unit Synchronization

- Sample clock synchronization
  - 12.5 GHz system sample clock
- Trigger bus
  - Tight channel-to-channel trigger synchronization among all units
- Control & Data Bus
  - UI, PI, DataStore in Master
  - PCIe Gen 2 x 4 lanes
  - Data processed in each Extension, aggregated in Master
- Configuration Manager software assists in correct connection

1 meter UltraSync cable

Multi-unit configurations

ULTRASYNC HIGH PERFORMANCE SYNCHRONIZATION & CONTROL BUS

- 12.5 GHz Sample Clock Reference
- Coordinated Trigger
- High speed data path

“Master”

“Extension”

Instrument Size Comparison

COMPACT AND BENCH MODELS

- Efficient rack-space for higher channel count
- Flexible location
  - Near DUT for shorter cables to preserve signal fidelity
  - Position monitor/mouse for convenient operation